REMARKS

Claims 1-13 are pending in this application. By this Amendment, claims 1, 6, 9 and 10 are amended.

I. The Claims Satisfy the Requirements of 35 U.S.C. §112, Second Paragraph

The Office Action rejects claims 1, 6, 9 and 10-13 under 35 U.S.C. §112, second paragraph. Claims 1, 6, 9 and 10 are amended to obviate this rejection.

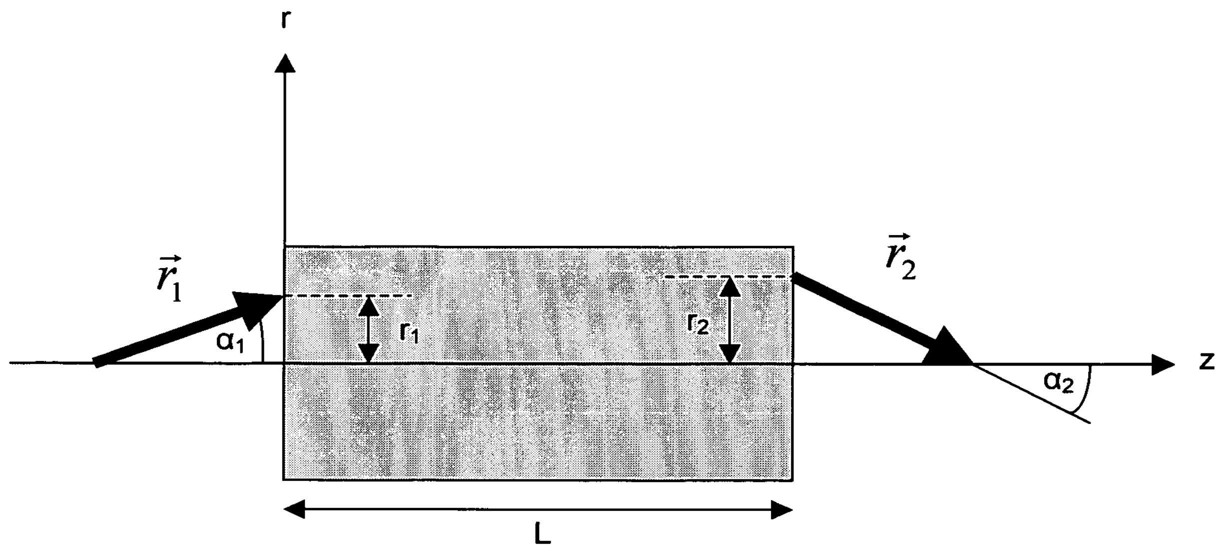
II. The Claims Define Patentable Subject Matter

The Office Action rejects claims 1-9 under 35 U.S.C. §103(a) over U.S. Patent No. 6,393,035 to Weingarten et al. ("Weingarten"). This rejection is respectfully traversed.

The invention of independent claims 1 and 7 include an optical imaging system described by ABCD-matrix with the restriction $D \approx 0$ ("...whereby D is substantially zero.") This restriction causes a perpendicular incident of the beam on a surface, especially a surface of a laser medium or an optical material degradable under light, even in the case of a movement or adjustment of the imaging mirrors or lenses. Thereby, a light spot can be moved over the surface of the material in order to use parts of the medium without damages. As one result of this approach the lifetime of such materials can be improved.

This restriction defines an optical property of the system. The restriction does not mean $D=0$ in a narrow sense as some minor deviations from the restriction could lead to a (desired) variation of the spot size on the medium.

The ABCD-formalism allows the design of complex optical setups with different components that still meet the restriction of the invention of claims 1 and 7. Using a mathematical abstraction two beams $r1$ and r_2 are given that enter or leave an optical medium with the length L. Both beams are vector quantities and sufficiently defined by length and angle.



For small angles α_i a paraxial approximation can be used

$$\sin\alpha_i \approx \tan\alpha_i \approx \alpha_i$$
$$\Rightarrow \alpha_i = \left(\frac{dr}{dz}\right)_{z_i} = r_i'$$

So, both vectors are connected by a linear transformation

$$r_2 = Ar_1 + Br_1'$$
$$r_2' = Cr_1 + Dr_1'$$

This system of equations can be expressed as a matrix:

$$\begin{pmatrix} r_2 \\ r_2' \end{pmatrix} = \begin{pmatrix} A & B \\ C & D \end{pmatrix} \begin{pmatrix} r_1 \\ r_1' \end{pmatrix}$$

Any optical system can be calculated – and therefore designed for a special purpose – by using the specific matrices of the optical components. The example below shows a system with three components.

$$\begin{pmatrix} r_2 \\ r_2' \end{pmatrix} = \begin{pmatrix} A_3 & B_3 \\ C_3 & D_3 \end{pmatrix} \begin{pmatrix} A_2 & B_2 \\ C_2 & D_2 \end{pmatrix} \begin{pmatrix} A_1 & B_1 \\ C_1 & D_1 \end{pmatrix} \begin{pmatrix} r_1 \\ r_1' \end{pmatrix} = \begin{pmatrix} A & B \\ C & D \end{pmatrix}_{System} \begin{pmatrix} r_1 \\ r_1' \end{pmatrix}$$

The invention of claims 1 and 7 require a systems matrix with an element D that is Zero under all conditions in order to get a perpendicular incidence on the optical material under all circumstances. Any other parameter may be varied as long as the restriction D=0 (or D≈0) is still valid. This mathematical formulation is a precise definition of the inventive concept while keeping the necessary degrees of freedom in the layout of the optical imaging system. See e.g., specification at page 6. The basis forms the assumption that r_1 is Zero as the beam propagates on the middle axis of the mirror M1. One restriction is that the beam propagates paraxially after leaving the system which means $r'_2=0$.

According to

$r_2' = Cr_1 + Dr_1' = Dr_1'$ (with $r_1=0$)

for all possible r'_1 of the incident beam this holds only if D is Zero.

Weingarten discloses an optical system with imaging means that consist of an optical imaging system 32 and an optical means 31. Both components are curved mirrors as disclosed in Figs. 1 and 2.

The specific matrix of a curved mirror is

$$\begin{pmatrix} 1 & 0 \\ -1/f & 1 \end{pmatrix}$$

Therefore, the matrix of the systems is derived by a multiplication of this matrix with an identical one in order to express the sequence of the two mirrors. Such a systems matrix will have an element D=1 under all circumstances. However, the system of Weingarten does not meet the restriction D=0!

The only way to get D=0 would be by adding further components with specific matrices in order to compensate the D=1 derived from the multiplication of the matrices of the curved mirrors.

Weingarten neither discloses nor suggests any further element that could be used for such purpose nor does it mention the teaching of the present application, namely the use of the ABCD-formalism with D=0. Furthermore, the Office Action provides no motivation to modify Weingarten.

The Office Action rejects claims 10-13 under 35 U.S.C. §103)a) over Weingarten in view of U.S. Patent No. 5,936,785 to Do et al. ("Do"). This rejection is respectfully traversed. Claims 10-13 depend from claim 1, which, as previously indicated, contains patentable subject matter.

III. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

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Attachment:
Petition for Extension of Time

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